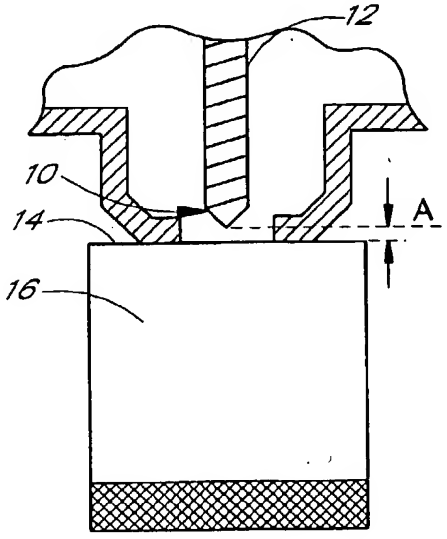

FIG. 1A
PRIOR ART

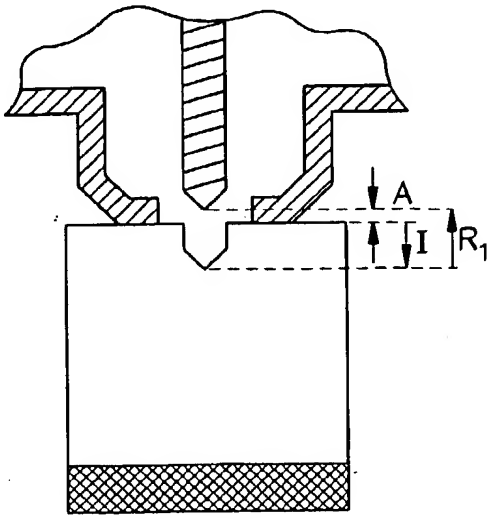

FIG. 1B
PRIOR ART

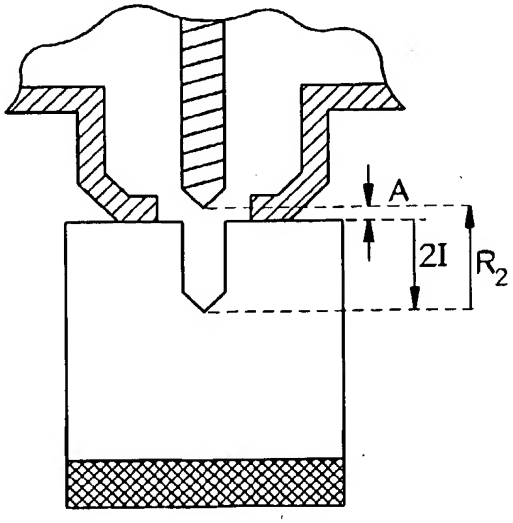

FIG. 1C
PRIOR ART

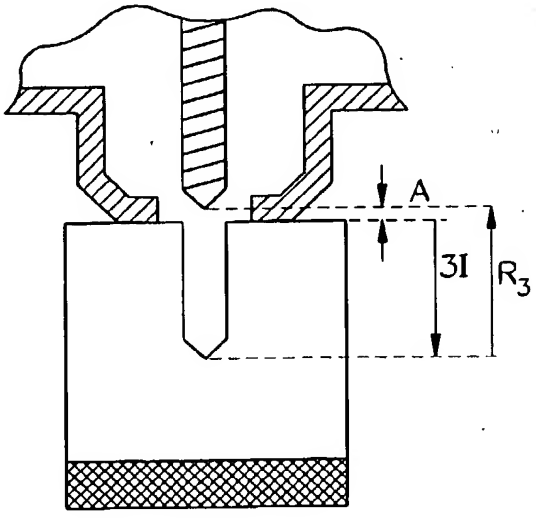

FIG. 1D
PRIOR ART

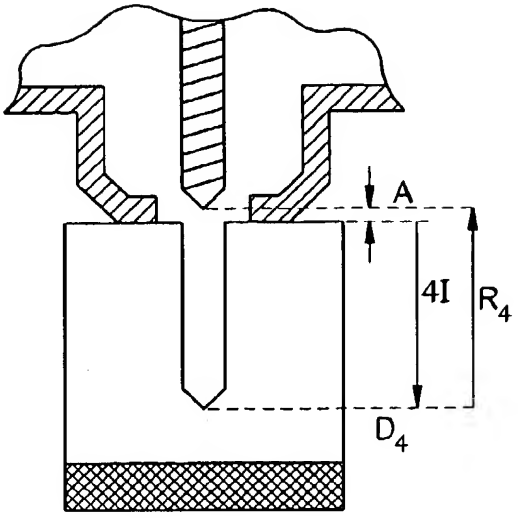

FIG. 1E
PRIOR ART

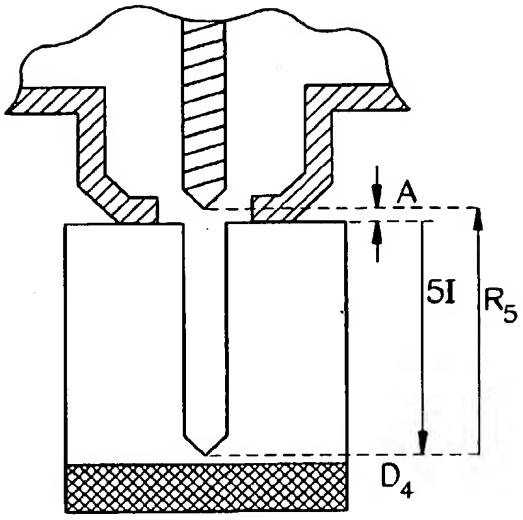

FIG. 1F
PRIOR ART

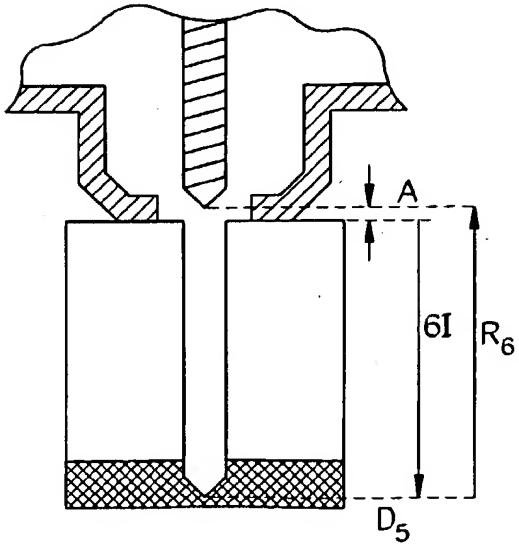

FIG. 1G
PRIOR ART

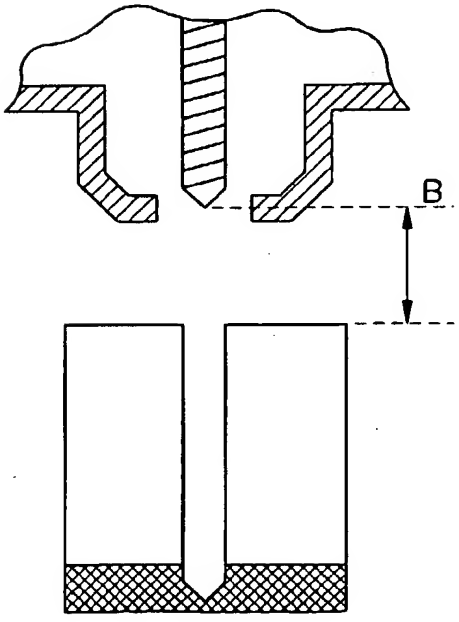

FIG. 1H
PRIOR ART

[0011] Further aspects, features and advantages of the invention will become apparent from the detailed description of the preferred embodiment which follows.

Brief Description of the Drawings

[0012] These and other features of this invention will now be described with reference to the drawings of a preferred embodiment, which is intended to illustrate and not to limit the invention. The drawings contain the following figures:

DH 9-18-04

[0013] Figures ~~1A-H~~ 1A, 1B, 1C, 1D, 1E, 1F, 1G, and 1H are schematic illustrations of a standard prior art method of incremental drilling.

[0014] Figures ~~2A-H~~ 2A, 2B, 2C, 2D, 2E, 2F, 2G, and 2H are schematic illustrations of a method of incremental drilling having certain features and advantages according to the present invention.

[0015] Figure 3 is a graph comparing the distance traveled in the z direction in the prior art and according to a preferred embodiment.

[0016] Figure 4 is another graph comparing the distance traveled in the z-direction in the prior art and according to a preferred embodiment.

[0017] Figures 5A and 5B illustrate wall smear incurred during the standard prior art method of incremental drilling and incremental drilling according to the preferred embodiment.

[0018] Figures 6A and 6B show the drill bit tip wear during the standard prior art method of incremental drilling and incremental drilling according to the preferred embodiment after 500 hits on a .390 inch think multi-layered panel.

[0019] Figure 7 is a perspective view of a of a multi-spindle printed circuit board drilling machine having certain features and advantages according to the preferred embodiment.

[0020] Figure 8 is a partially cross-sectioned elevational view of a single spindle of the multi-spindle printed circuit board drilling machine of Figure 4 with the spindle in a raised position;

[0021] Figure 9 is a partially cross-sectioned elevational view of a single spindle of the multi-spindle printed circuit board drilling machine of Figure 4 with the spindle in a lowered position;

[0022] Figure 10 is a schematic illustration of a controller used to control the multi-spindle printed circuit board drilling machine of Figure 4;

DH 9-18-04

[0023] Figures ~~11A-D~~ 11A, 11B, 11C, and 11D illustrate exemplary routine that can be used to employ certain features, aspects and advantages of the preferred embodiment.

[0024] Figure 12 is a schematic partially cross-sectioned elevational view of a single spindle.

[0025] Figures 13A and 13B illustrate set up screens for receiving pecking parameters.

[0026] Figures 14A and 14B illustrate display screens for displaying increments.

[0027] Figure 15 schematically illustrates a modified embodiment of an improved incremental drilling method.

Detailed Description of the Preferred Embodiment

[0028] Figures 1A-H illustrate a standard prior art method for incrementally drilling holes in a printed circuit board. This method will be referred to as "standard incremental drilling" As shown in Figure 1A, in the standard incremental drilling, a tip 10 of a drill bit 12 is initially located at a retract position, which is a distance A above a top surface 14 a work stack 16. In this example, a hole through the work stack 16 will be drilled in six equal increments I. For the hole to extend through the stack 16, the sum of six increments (i.e., 6I) must be greater than the depth of the work stack 16. More/less increments or smaller/larger increments can be used depending on the depth of the work stack 16, the material composition of the work stack 16, the diameter of the drill bit 12, the drilling rotational speed, the drilling axial speed and/or other relevant parameters. Of course, the method described below can also be used to create blind vias (i.e., holes that do not extend completely through the work stack 16).

[0029] During the first step (Figure 1B), the drill bit 12 forms a first increment by drilling one increment I into the work stack 16. The drill bit 12 then retracts to the retract position. During the retract step, the drill bit travels a retract distance R_1 that is equal to the sum of the first increment I and the distance A.